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ABSTRACT

Fifty-five preschool children, ages three and four, used an Apple II microcomputer to learn reading readiness concepts of "above," "below," "left," and "right." Available during indoor play periods for three weeks at a nursery school on the Stanford University campus, the microcomputer was accepted enthusiastically by children, teachers, and parents as an activity center, and criterion tests on the four reading skill concepts showed that children improved after the 3-week period with the microcomputer. Color graphics, music, and voice response to keyboard inputs by the children were elements used in the program, and children evidenced considerable enjoyment using the computer. While the Apple was monitored at all times by a research assistant, the children soon learned how to operate it properly and how to take care of both the microcomputer and the diskettes used to run the program. (Author/BK)

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PRESCHOOL CHILDREN USE AN APPLE II TO TEST READING SKILLS PROGRAMS

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January 28, 1981

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FIELD TEST REPORT FOR APPLE EDUCATION FOUNDATION

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January 28, 1981

PRESCHOOL CHILDREN USE AN APPLE II MICROCOMPUTER TO TEST READING SKILLS PROGRAMS

Fifty children at Stanford's Bing Nursery School recently participated in the field test of a reading skills program prepared under an Apple Education Foundation grant. The computer programs used colored graphics, music, and digitized voice to present reading readiness concepts. Children used an Apple II keyboard divided into above/below and left/right sections to create effects on a color television screen with voice prompts and musical sounds. As children pressed keys, color bars appeared, boxes filled with color, and rainbows with dancing colored rain appeared. Simple chant melodies also accompanied the appearance of butterflies with random new wing colors. Animated jugglers introduced and concluded the programs in a skill set prepared to show possibilities for early skill learning with a microcomputer.

The purpose of the field test was to determine:

1) whether using a microcomputer in a preschool classroom is feasible (is the computer disruptive; do teachers, parents, and children accept the computer; do children damage equipment, what kind of monitoring is needed);

2) whether children are able to move through the lesson sequence easily (can they use the standard keyboard; do they pass criterion tests built into the program; does the timing of prompts seem optimal; do they gain mastery of the lesson structure; do they express interest or frustration; how do they respond to musical vs. voiced segments and abstract graphics vs. pictures);

3) whether children learn concepts of above, below, left, and right (do test scores improve after using the computer program);

4) whether children gain in computer literacy (do they use computer terms; can they load diskettes; do they use various input devices with greater skill; can they plug in cords and turn on the monitor; can they use software appropriate to their skills);

skills);

5) whether the presence of the computer influences classroom discussion and activities in a way that could influence concept learning (are directionality concepts discussed more; do teachers or children use concepts in songs, stories, or outdoor activities);

6) how girls versus boys approach the computer (do they ask for turns, persist in interest, talk about the experience, ask questions, ask to do alternate activities, use the program);

7) do children whose first language is not English have difficulty with the English voice sections of the program (do they approach the computer; do they express more frustration than other children with the voiced portions of the program);

8) is the program in use while it is available (are there long periods when the computer has no children using it; do many children ask for turns; does this change as time goes on and the children have had turns)

METHOD

Children in one classroom participated in the field test. They were pre-tested, used the program freely for three weeks with observers present, then they were post-tested.

SUBJECTS. Fifty children, aged three and four years old, attended West Room at Stanford University's demonstration and experimental nursery school during the field test. Enrollment at the school is open to all, with many children from Stanford University faculty and student families or from families in the community surrounding Stanford. Children in the class speak several languages other than English, including Spanish, Greek, Korean, and Arabic. The classroom serves working and student parents who need all day care for their children as well as children who come for half-day sessions twice or three times a week. Two groups of teachers manage the classroom, one group in the morning and one in the afternoon. There are usually about five adults in the room, including teachers, aides, student observers, researchers, and visitors. Some sessions have up to thirty children present, others as few as fifteen.

The day is structured with definite activities including indoor play at activity centers (when children were tested and used the computer as one option along with painting, puzzles, playing hospital, crafts, and other activities), outdoor play, snack and nap times, and large group (story, song, and discussion times) and small group activities (focused social and concept

learning with an assigned group). Children and teachers are accustomed to research procedures and the presence of observers since that is a daily occurence for them.

PROCEDURES. An experimenter asked children to accompany her to a room within the classroom for an activity. The experimenter presented a Random House Criterion Reading test of basic skills for each concept.

For "above" children were asked, "Point to the line that is above the other line," and shown a picture of two nearly parallel horizontal lines on a page. A modification from the published test was that children were asked to point to the objects rather than to draw an "x" on them. Drawing an "x" requires knowledge of the alphabet and manual dexterity some of the children were not ready for at age three and four. The test was designed for older children. There were three items for "above" and for each of the other concepts because children could guess correct answers. Another modification made for young children was to place each item on a separate page to avoid confusion among items. For "below" children were asked to point to the circle below another circle on a page. For "left", children pointed to one of two sqares for each item. For "right" children pointed to a vertical line to the right of several others.

If children got all three items correct, they were scored as passing on the concept. If they missed one item, they failed. This was neccessary since many items could be guessed with a 50-50 chance of being correct.

After the test, children were invited to play with an electronic musical toy which repeated patterns they entered by pressing buttons with colored lights. This was added to the test experience so that children would enjoy coming to the test room. Testing was concluded in one week of 45 minute sessions in the morning. Children attending only afternoon sessions were not tested.

APPARATUS. For three weeks an Apple II microcomputer was set up in the nursery school classroom each morning before children arrived at 9 A.M and after their outdoor play time at 4 P.M. The computer was equipped with a disk drive, language card, and Supertalker. Experimenters used a table in the classroom to set up the microcomputer, with a 13 inch Sony color television directly behind the computer, and the supertalker speaker to the right. The disk drive was placed to the left near where the experimenter sat. The Apple II Plus was equipped with 48K bytes of random access memory, which was needed for the program. The Apple II language system was used to operate the program in Integer Basic in order to use Programmer's Aide #1 for generating

music. The Apple Education Foundation supplied all equipment, with the Supertalker (speech digitizer) donated by Mountain Computer for this project. The monitor was placed behind the computer to help childred relate the video display to the keyboard and to assure that there was sufficient distance from the television to minimize exposure to radiation coming from the screen.

Children used paddles (knobs which move objects around the screen and buttons which create various effects) to operate a jumping frog program called Ribbit, after they had finished the program being tested.

The computer remained available during indoor play time the first hour of each day, and during the late afternoon indoor play period the hour before children prepared to leave for the day. An experimenter rolled the computer into the room on a cart, set it up on a low table, loaded the programs (with the three and four year olds inserting diskettes and turning on the computer and monitor). As the experimenter performed procedures, she named each item being used. She opened the computer to show children the area where memory chips are, where the peripheral card for the supertalker is, and where each cable leads. She also explained briefly what various sounds and lights indicate. The experimenter was assisted by a teacher in arranging turns and by a research assistant in monitoring the apparatus during observation periods. The computer was not left unattended.

Following the three week period, children followed the same procedure for post-testing as they had for pretesting. A break for Thanksgiving delayed post-testing several days and shortened the experimental period.

RESULTS

The Apple II and the program were enthusically accepted by the school and the children. Children improved in test scores on the concepts tested and began using computer terms.

The following specific results were found as a result of observation and testing:

1) The microcomputer was welcomed by parents, children, the university and school administration, teachers, and aides. There was such a high degree of interest in three and four year olds using such a colorful, musical program that during the first week the computer was in the room, there was a small crowd of both children and adults around it. It was difficult for the child using the computer to hear voice prompts, and probably to use his or her turn with comfort since there was so little privacy and

there were so many little eager children clustered around wanting a turn. At this period it seemed that it might be preferable to structure turns and waiting more rigidly or move the computer to a location out of the classroom mainstream. On the other hand, many children could watch as others approached this new device, without they themselves being on the spot to perform with the computer.

There were up to twenty observers at a time, including up to eight parents. Turns were given on a "first come, first served" basis, with a waiting list which served several purposes. The list provided data on how many children requested turns, whether they were boys or girls, who had turns, and it showed children where they stood on the waiting list. During each session the first week over twenty children per period requested turns. It took each child five to ten minutes to complete a turn so some children had to wait until the next session for a turn. Preference was given to children who had not previously had a turn, and by the second week children learned that they would all have an opportunity to use the computer. They learned that noone got over two turns a day so stopped asking for more. They also sensed the timing of turns and returned to their play confident that they would be called when their turn was approaching. If children were too busy to come (as when they were in the middle of constructing a block bridge or finishing a painting) they were given the next turn when they were ready. By the third week the computer was in constant use, but usually with only one or two onlookers.

There were some three and four year old computer enthusiasts who managed to get twelve turns in the three weeks, but most children had one or two turns per program. Children almost never left the computer voluntarily; experimenters told them their turn was over when they had moved through the cycle of three lessons once (if they got the concepts readily) or several times (if they had difficulty). Experimenters acted as helpers if children were having difficulty, suggesting pressing the space bar to move on to another lesson if children seemed frustrated or encouraging them to keep pressing keys to see what would happen. Children did not use the computer alone and seemed to enjoy sharing their discovery of concepts with the experimenters. Research assistants commented that "you could see learning happening." Thus the computer was disruptive in a positive way at first and settled into busy, quiet use by the end of the three weeks.

Teachers in the classroom expressed very positive attitudes about having the computer present and said that children missed it when the field test was over. Teachers said that the computer tended to crystalize concepts for the children and to provide feedback on whether concepts are mastered. They reported that

they use terms such as 'left' and 'right' many times a day, but that they are not sure when children have mastered the concept. On the computer, children got immediate feedback and they could tell when they were getting the idea. Teachers emphasized that children aged three and four have discoveries all the time, and that the 'aha' experiences noted by people watching the children using the computer should be considered in that light. Teachers were pleased that children continued to seek social contact with the other children and adults near the computer, that they could make the computer experience a social one so that they were not relating to a machine without other people. One teacher noted that a child wrote other children's names (with help on spelling from the researcher) to keep a list of turns, a well developed social function for a three year old. A teacher also reported that children began to sing songs that were used in the program even though they had never been poresented in class. She also reported that she tired of the high pitched noise (digitized musical notes) the computer made. Both head teachers and all other teachers who commented expressed willingness to participate in additional computer projects for young children.

Several parents called the experimenter with enthusiastic comments such as, "My child has never talked so much about a school activity." Some parents expressed interest in obtaining the program, or even in buying an Apple II in order to use similar programs. The head of the panel for protection of Human Subjects at Stanford reported that the project caused him a problem--his daughter in the classroom using the Apple II wanted a computer for Christmas. Programmer parents expressed interest in creating similar programs and a teacher spouse is considering volunteering programming time to help Bing School obtain an Apple Education Foundation grant. Parents interviewed for a network television special about this project reported that they consider having a computer project in a preschool is a great priviledge and could help prepare their children for a future that will surely involve computers in their daily lives. They felt that having an early computer experience would give them a head start. It was more the possibility of becoming comfortable with a computer at a young age than the specific concepts taught that was of interest to the parents.

The school invited the experimenter to present the equipment and programs at a faculty meeting. The experimenter demonstrated the apparatus for all the teachers and offered to help them try it out in their classrooms but although many teachers seemed enthusiastic, none used the Apple II on their own. If the computer were available for a longer period, it seemed likely that all Bing classrooms except the Toddler Room (for 18 month olds) would use the computer. Some personal demonstrations would probably be very helpful in getting classrooms started with the

computer.

children loading diskettes never damaged a diskette and treated the computer very carefully. One child approached the computer immediately after using wet adobe clay but did no damage before being intercepted by a researcher. It seemed necessary to have a trained person available to monitor the computer in a nursery school setting if standard equipment is used (ALT has prepared a children's keyboard modelled on that used at Sesame Place that could stand up to paint, playdough and clay.)

2) Some children moved through the lesson sequence with one trial learning, evidenced by passing every criterion test item on the first trial. These children listened to the voice, watched carefully and moved slowly and deliberately through the sequence. Other children made repeated keypresses which made it impossible for them to tell which keypress created the next effect. The computer was programmed to accept new inputs only after the sequence of graphics, music, and voice was complete. for sentences like, "That key was on the right, now touch one key on the left," the listening period required could last up to two seconds, a very long wait for some preschoolers. Fast output for each input seemed essential for these children.

On the other hand, children under three who tried out programs in our office often did not seem to make the connection between a keypress and an effect on the screen unless a long musical response was made so they could look up from the keyboard to see what happened. These children pressed the space bar repeatedly, which generated two bars of music and a plain screen full of color. They were amused doing this for some time.

Most children moved through the sequence two or three times before getting the idea of what the computer directions were asking. The program presented a play exercise followed by a test with the same format and voiced directions. If children made two mistakes, the computer jumped to play mode, telling them what key they had pressed, but not emphasizing the error. Children generally passed criterion tests within two trials, then learned that they could control the program sequence by pressing the space bar, jumping to the "pretty part" where they could generate a rainbow or butterfly. This mastery of the program structure seemed to come after they mastered concepts. The tasks were not of great interest after children could do them easily, but generating rainbows with cycling colors and dancing rain remained engaging. Children asked to use the picture sections of the programs for lengthy periods; they talked about arranging colors in various ways and creating rain dances. There were clearly several layers of learning and mastery.

The voiced portions of the program were designed to be the real teaching sections. Each lesson had two voiced portions with brief comments and directions. The picture and music portions of the program were conceived as rewards to be used after children passed the tests. We allowed children to use all three portions of the program freely, however, and discovered that children sometimes first understood the concepts while using the freer, playful music and picture lessons. They then returned to the voice portions and passed tests, adding words to the discovery they made in the musical and pictorial sections of the program.

Overall the structure of the program seemed a useful learning tool, with a workable sequence of lessons. Several changes were suggested, such as the sequence of voice and music so that the appearance of graphics were paired with the right words.

3) Tests of the target concepts before and after the computer experience had striking results. On the pretest, 39% of the chilren passed tests of above, below, and left. 32% passed the test of the concept, "right." On the post-test 70% passed the test for above and below, 57% for left and 44% for "right." (See plot of results in appendix.) The average improvement on basic pre-reading skills was considerable. We are not using statistics to analyze these data because of the uniqueness of the population in this university community, because the sample represents children in only one classroom, and because a program developer was present with children throughout this unfunded field test. We consider this a promising pilot study. Further research is needed to verify the results in a broader, more objective setting.

4) Children successfully used the computer within their ability (most did not know the alphabet or numbers so programming was not feasible). As described above, they loaded programs, helped set up the equipment, and showed considerable interest in the computer. They asked to touch chips, asked if it got hot in the computer, asked why lights went on and sounds occurred. They were delighted when a new program was loaded so they could insert diskettes. They held diskettes properly and learned to close the disk drive door and press the return key without prompting. They referred to the disk drive by name and delighted in seeing inside the computer when we fitted it with a plastic cover. They asked questions that were hard to answer, such as what the "cute little purple bottle" (capacitor on the controller card) did. Children referred to diskettes, paddles, to the Apple II, and to the Ribbit program by name. They certainly did not seem intimidated by the hardware in any way.

5) The presence of the computer did seem to influence classroom

activities in a way that could influence learning of the concepts being tested. Butterflies and rainbows were prevalent in children's art while they were using the program. Teachers commented that children used directionality words in their outdoor play more during the time the computer was present, not only those concepts presented, but others also. The experimenter noted teachers singing a left/right song with children, teachers using directionality words with particular emphasis, and reading stories presenting these concepts. Bing teachers carry out themes in many of the children's activities. The learning of concepts could not be attributed to the computer program alone, but the programs seemed to influence activities in a way that could accelerate learning of concepts. The experimenter's child who used the programs with her classmates began asking left/right questions during the field test and has continued to do so for a month. She asks if things are on the right or left of the car while driving and asks which shoes she is putting on. other parents reported similar questions arising at home, and attributed them to the computer experience.

6) More girls than boys asked for turns on the computer and persisted in getting turns (boys seemed to be less able to wait the minute or two that was necessary to start their turns). But there were more girls than boys in the class, so the proportion of girl to boy interest was not as striking as it first appeared to experimenters. We were particularly interested in girl interest because colleages and observations in schools indicated that school age children seem to label optional computer activities a boy's domain. This was not the case at the preschool level with the kind of program used in the field test. The graphics and music were designed to be neutral on sex stereotypes, but many computer games (usually designed by male programmers) have rocket shooting themes that seem more appealing to boys than girls. This area would be interesting to pursue more systematically. The digitized voice on the computer had both male and female segments, which the children noticed and commented on. They wondered why there was a 'girl's' voice (which occurred on the second set of lessons). The only time there was a significant change in the number of boys versus girls approaching the computer was when a male programmer visited. The little boys came immediately and stayed throughout the session with very few girls participating. Usually a woman monitored the computer, just as women teachers usually ran the class.

7) It seemed that some children who did not speak English as a first langauge were more hesitant to use the computer and had more difficulty using the program. It would be possible to have their parents enter voiced commands in their home language for a special experience at school. Young children are extremely flexible linguistically, and this did not seem essential. One

group of girls who were the most avid computer users turned out to be new users of Engligh. One spoke only Greek the year before and the other two only Spanish. The Supertalker could provide alternate languages for children who have more difficulty than these bright little girls. All the multi-lingual children eventually asked for turns with the computer and fared quite well.

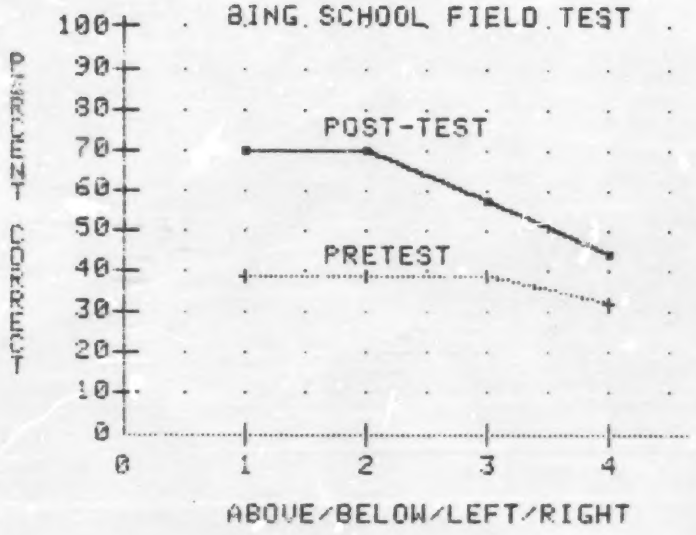
8) There was never a sixty second period when the computer was out of use during the field test. In 19 sessions, children requested turns 245 times, and took 147 turns. Of an average of 24 children present, 13 asked for turns and 8 received turns during one hour. Of fifty children present during the field test, only two did not ask for a turn. Requests for turns were approximately equal for three and four year olds, boys and girls. Occasionally the experimenter left the computer to ask a child if he was ready for a turn previously requested, and asked a few children if they would like to try the computer if they had not before. Most were eager to try it, and the experimenter asked children only once during the field test so that noone was pressured to use the computer. Children dictated comments to their teacher after the experience. They said that they liked the rainbow and butterfly, liked the song, 'Rain, Rain, Go Away,' and that they liked the computer to talk. They also liked the "froggie" in the Ribbit program. Several children approached the experimenter in the weeks after the field test and asked when the computer was coming back. They clearly enjoyed the experience.

CONCLUSIONS AND RECOMMENDATIONS

The Apple II and the Above/Below and Left/Right programs were effective learning devices at Bing School. Developing a series of programs of this type seems a promising possibility. This would require funding to assure that a systematic curriculum is developed. A basic skills curriculum on microcomputer could be a powerful learning tool, but research is needed to determine requirements for teacher training, monitoring of equipment, local community reactions to the use of computers with young children, and specific skill areas that can be taught effectively with a computer.

This pilot study suggests that children who are very young can use computers easily and gain in skills. They can use game paddles, a joystick, and the standard keyboard divided into zones. Clearly preschool children were not intimidated by a microcomputer and enjoyed using it as part of their play. Since computers are likely to be such an important part of their world, preschool does not seem to soon to introduce children to playful, interactive computer experiences.

Appendix A


BING SCHOOL FIELD TEST
POST-TEST
PRETEST
PERCENT CORRECT
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ABOVE/BELOW/LEFT/RIGHT